R E P O R T   R E S U M E S

ED 018 882   40   EC 000 520

EFFECTS OF OVERTRAINING ON REVERSAL AND NONREVERSAL SHIFTS IN NORMAL AND RETARDED CHILDREN. FINAL REPORT.

BY- MINER, GLADYS   VINEY, WAYNE
OKLAHOMA CITY UNIV., OKLA.

REPORT NUMBER OE-BR-6-8023   PUB DATE   MAY 67
GRANT   OEG-32-46-0200-6029
EDRS PRICE   MF-$0.25   HC-$0.64   14P.

DESCRIPTORS- *EXCEPTIONAL CHILD RESEARCH, *MENTALLY HANDICAPPED, *LEARNING, EDUCABLE MENTALLY HANDICAPPED, VERBAL OPERANT CONDITIONING, GRADE 4, LEARNING CHARACTERISTICS, DISCRIMINATION LEARNING, TRAINING, TRANSFER OF TRAINING, TASK PERFORMANCE,

TO STUDY THE EFFECTS OF OVERTRAINING ON REVERSAL AND NONREVERSAL SHIFTS OF CUES, 96 NORMAL (MEAN AGE = 117 MONTHS, MEAN IQ = 109.8) AND 96 RETARDED CHILDREN (MEAN AGE = 119 MONTHS, MEAN IQ = 70.1) WERE TESTED ON A SIMULTANEOUS 2-CHOICE DISCRIMINATION TASK. SUBJECTS WERE TRAINED ON TWO LEVELS (CRITERION AND OVERTRAINING). FOLLOWING TRAINING ON THE ORIGINAL TASKS WITH SHAPE, HEIGHT, AND BRIGHTNESS AS DISCRIMINANDA, THE SUBJECTS WERE TRANSFERRED TO A REVERSAL SHIFT (RS), NONREVERSAL SHIFT-IRRELEVANT DIMENSION (NRS-ID), OR NONREVERSAL SHIFT-NEW DIMENSION (NRA-ND) TASKS. SMALL TANGIBLE REWARDS WERE OFFERED. SIXTEEN SUBJECTS WERE TRAINED IN EACH OF THE 12 EXPERIMENTAL CONDITIONS. RESULTS IN THE CRITICAL TEST CONDITIONS INDICATED (1) A SIGNIFICANT SHIFT EFFECT (P IS LESS THAN .001), INDICATING THE RELATIVELY GREATER DIFFICULTY OF RS AND NRS-ID PROBLEMS, (2) A SIGNIFICANT TRAINING EFFECT (P IS LESS THAN .001) FROM OVERTRAINING FOR BOTH NORMAL AND RETARDED SUBJECTS IN ALL TRANSFER TASKS EXCEPT FOR NORMAL SUBJECTS ON NRS-ID PROBLEMS, AND (3) NO RELIABLE LEARNER OR LEARNER SHIFT INTERACTION EFFECT (P FOR BOTH IS LESS THAN .10). THE STUDY THEREFORE SUGGESTED THAT THERE MAY NOT BE A FUNDAMENTAL DISCONTINUITY BETWEEN THE DISCRIMINATION PERFORMANCE OF NORMAL AND RETARDED SUBJECTS. THE NEED FOR FURTHER RESEARCH INTO THE REASONS FOR THE FACILITATING EFFECTS OF OVERTRAINING WAS INDICATED. A SECOND STUDY INTRODUCED VERBALIZATION IN AN ATTEMPT TO INVESTIGATE ITS EFFECT UPON TRANSFER PERFORMANCE ON RS, NRS-ND, AND NRS-ID PROBLEMS OF 48 RETARDED SUBJECTS. RESULTS INDICATED THAT, WHILE VERBALIZATION SIGNIFICANTLY FACILITATED LEARNING THE ORIGINAL TASK (P IS LESS THAN .001), IT HAD A LIMITED FACILITATING EFFECT UPON TRANSFER TASKS. THREE TABLES PRESENT DATA, AND A BILBIOGRAPHY LISTS 11 ITEMS. (DF)

417 (543) ERIC

ED018682

FINAL REPORT
Project No. 6-8023
Grant No. OEG 32-46-0200-6029
PA 40

EC000520

EFFECTS OF OVERTRAINING ON REVERSAL AND NONREVERSAL SHIFTS IN NORMAL AND RETARDED CHILDREN

May 1967

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

Effects of Overtraining on Reversal and Nonreversal Shifts in Normal and Retarded Children

Project No. 6-8023
Grant No. OEG 32-46-0200-6029

Gladys Hiner
Wayne Viney

May 1967

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Oklahoma City University

Oklahoma City, Oklahoma

Introduction

Recent experiments have demonstrated superior reversal shift (RS) performance by fast learners as opposed to slow learners (Kendler & Kendler, 1959) and normal subjects as opposed to retardates (e.g., Balla & Zigler, 1966; Sanders, Ross, & Heal, 1965). One explanation (Kendler, Kendler, & Wells, 1960; Kendler & D'Amato, 1955) of these results assumes that faster learners develop a dimension specific mediating response during an original discrimination task. According to this explanation, reversal of the positive and negative cues with the task specific dimension, as in an RS problem, should be handled with relative ease because the mediating response is somehow relevant to the entire dimension. If, however, a subject is required to learn a nonreversal shift to a new dimension (NRS-ND) or a nonreversal shift to a previously present but irrelevant dimension (NRS-ID), the presence of the mediating mechanism would retard transfer performance.

A related explanation (Luria, 1961) assumes that slow learners and retardates lack communication between verbal and motor systems. The persistence of motor responses not connected to proper verbal cues could also result in poor performance in RS type problems.

Another type of explanation has been proposed by Sutherland (1959). According to this explanation two processes are involved in learning a simple discrimination problem. Sutherland's account as explained by MacKintosh (1962) states that "the two processes are, first, the switching in of an analyzing mechanism specific to a given stimulus dimension, and second, the attaching of responses to the outputs of this analyzer." The better focused the analyzer, the greater the probability of responding to relevant cues. This explanation predicts that increased amounts of training on the original discrimination problem (resulting in better focusing of the analyzing mechanism) will result in faster RS performance. Although the results of studies on the overtraining reversal effect (ORE) are not equivocal, there is reasonable evidence that such an effect may be obtained (e.g., Cross & Tyer, 1966; MacKintosh, 1962; Sitterley & Capehart, 1966; Youniss & Furth, 1965).

The interesting aspect of the ORE phenomenon is that it raises questions as to whether dimension specific mechanisms or mediating mechanisms could be developed in slow learners or retardates during extended training sessions. The purpose of this experiment, therefore, was to explore the relative effects of overtraining upon RS, NRS-ND, and NRS-ID performance of both normal and retarded children. The following hypotheses were raised.

1. Overtraining will facilitate RS performance of retarded but not normal subjects. The prediction concerning normal Ss follows from the idea that the RS performance of normal Ss should be near asymptotic levels following criterional training because of the presence of mediational responses. Overtraining should provide additional time for retardates to develop appropriate mediating or analyzing mechanisms.

2. Overtraining should retard NRS (ND) and NRS (ID) performance, and this effect should be more pronounced in normal than retarded Ss. Again, the presence of a dimension specific mediating or analyzing mechanism should retard performance when a new dimension or previously irrelevant dimension is introduced.

Method

Subjects

Ninety-six normal and ninety-six retarded children from 10 different public schools in Oklahoma City, Oklahoma, were tested. Retarded Ss all came from special education classes while normal Ss came from regular fourth-grade classes. Mean CA for retardates was 119 months while that for normals was 117 months.[1] Intelligence quotients taken from school records indicated a mean I.Q. for normals of 109.8 while that for retardates was 70.1. Only those subjects who were able to solve the original discrimination problem within 75 trials were used. On this basis 127 normals and 129 retardates were tested.[2]

---

[1] Ss were matched on the basis of CA as opposed to MA because we felt this provided a better test of hypothesis #1.

[2] Careful evaluation of a number of related studies indicates that it is not uncommon to find Ss who do not learn the original discrimination problem within a set number of trials. We were surprised to find as many nonlearners in the normal group as in the retarded group. Most

Apparatus

The apparatus consisted of a one-inch flat unpainted piece of plywood 12 inches wide and 18 inches long. This board was divided lengthwise by a perpendicular screen which was 12 inches high and 18 inches in length. The base and screen were mounted on a swivel device making it possible to turn the apparatus in a 360 degree circle. On one side of the apparatus were two 3/4-inch depressions six inches apart in which a token reward, consisting of a marble, could be placed. The depressions were felt lined for the purpose of minimizing any possible auditory cues. When the side of the apparatus containing the depressions was turned toward E, the token reward was placed in one of the depressions and was then covered with one of the discriminanda. The 12 x 16 perpendicular board served to screen E's actions so as to minimize any possible position cues. After the token reward and the discriminanda were in their appropriate places, the apparatus was turned 180 degrees so as to face the subject, who was sitting directly in front of the experimenter.

The dimensions were shape, height, and brightness. Specific discriminanda included tall (5 inches high) and short (3½ inches high) metal tumblers and 3-inch wooden squares made of ¼-inch plywood along with ¼-inch plywood circles equated with the squares for area. There were black and white members for both shape and height discriminanda.

Procedure

All Ss were run individually in rooms which were quiet and isolated. E and S were always alone during testing sessions. When S first arrived at the experimental room, he was greeted and engaged in informal conversation. After establishing a friendly and relaxed atmosphere, conversation was directed toward the discrimination apparatus and a large collection of small toys, trinkets, and prizes to be used as incentive.[1]

---

of our nonlearning subjects later mentioned that they were attempting to find a more difficult solution to the problem. There were no I.Q. differences between Ss who learned the original task and those who failed to learn it.

[1]The tangible prizes seemed to produce considerable enthusiasm and motivation.

Ss were given the following instructions:

> We are going to play a game which is called "Find the hidden marble." You will notice that I can hide a marble in one of these wells by covering it with one of these objects. Your job will be to pick up the object under which you think the marble is hidden. If you find the marble, you may put it in this container (each S was given a plastic container) and keep it until the game is over. If you don't find the marble, I will turn the table around, hide the marble again, and you can try again. You may choose only one object at a time and the object of the game is to win the marble every time. After the game is over, you may trade your marbles for one of these prizes.

When it was evident that S understood, the testing session was begun.

Reward, consisting of the marbles, was placed in the right or left wells on a random basis and covered with the appropriate positive discriminanda. A control for run effects was uses so that if one object occupied one position for three successive trials, it was automatically changed on the fourth trial.

Experimental Design

The experiment was of the 2 x 3 x 2 variety with normal and retarded children, RS, NRS-ND, and NRS-ID problems, and criterion and overtraining. Normal Ss and retarded Ss were randomly assigned to each of the experimental conditions. There were 16 Ss in each of the 12 conditions.

In initial training, a given subject might be required to solve, for example, a circle-square (shape) problem with the square being the positive stimulus. If that S were assigned to a reversal shift group, then the critical test problems consisted of a shift from the formerly rewarded (square) to the formerly unrewarded (circle) cue. An NRS-ND problem might originally involve shape with the second or transfer problem involving height. A subject required to solve an NRS-ID problem who was initially confronted with shape (relevant) and brightness (irrelevant) was confronted with brightness (relevant) in the transfer task. In order to control for secondary reinforcement effects, shape was held constant in the transfer task and the different shapes utilized in initial training were presented successively. Criterion, in both initial and transfer conditions was 9 successive correct choices. Subjects in overtraining groups were immediately, upon reaching criterion, given 150% additional training. For example, if S's score, including the nine successive correct choices, was 12, then he was given an additional 18 trials before being shifted. In each of the 12 experimental conditions all permutations of the discriminanda were utilized. Immediately upon completion of initial training, Ss entered into the critical test conditions without further instructions.

Results and Discussion

Means and SD's for initial discriminations and transfer discriminations are presented in Table 1 (see Appendix 1). Since it was unlikely that transfer data were independent of initial learning data, an analysis of covariance[1] was conducted. Because the data (based on trials to criterion) were heterogeniously variable and because the means and variances were correlated, a log transformation was performed. The analysis indicated a marked trend for overtraining to facilitate transfer performance ($F=12.53$, $df=1/179$, $P < .001$). An examination of Table 1 indicates that the effect of overtraining is fairly consistent and not limited to RS problems or retarded Ss. The one exception, likely attributable to random variation, was the condition in which normal Ss performed NRS-ID problems. There was also a significant shift effect ($F=14.02$, $df=2/179$, $P < .001$) indicating the relatively greater difficulty of RS and NRS-ID problems as opposed to NRS-ND problems. Interestingly, there was not a large and reliable difference for the learner variable ($F=3.00$, $df=1/179$, $P < .10$), surprising in view of the fact that normal Ss and retarded Ss were selected on the basis of chronological age instead of mental age. The only other condition which approached significance was the shift x learner interaction ($F=2.59$, $df=2/179$, $P <$ $.10$). The learner x training, shift x training, and

[1]Analysis of variance based on performance on the second task agreed with the analysis of covariance with the exception that the learner x shift interaction was significant ($F=6.22$, $df=2/180$, $P < .01$).

learner x shift x training conditions all yielded F values less than one.

The failure to find a reliable learner effect may be partially attributable to selection of Ss on the basis of their ability to solve the original discrimination problem within 75 trials. Thus, in addition to being selected on the basis of CA, Ss were equated on the basis of original learning ability. It is of interest, however, that as many normals as retardates had to be replaced, evidence that failure to learn the original task was independent of the learner variable.

The failure to find more than marginal significance in the learner x shift interaction may also be partially attributable to selection of Ss on the basis of original learning ability. The direction of the learner x shift data is consistent with previous findings (e.g., Sanders, Ross & Heal, 1965) that RS problems are more difficult for retarded than normal Ss, and inconsistent with those studies indicating slower NRS performance for fast as opposed to slow learners (Kendler & Kendler, 1959) and normal as opposed to retarded subjects (Sanders, Ross & Heal, 1965). One possible reason for this discrepancy is that the problems utilized in the present study were relatively easier than those used in the other studies. Thus, any inhibiting effect of a dimension specific mediating response may depend upon a certain level of complexity in the original and transfer tasks.

The results of overtraining confirm the results of previous studies (Cross & Tyer, 1966; Youniss & Furth, 1964) reporting a facilitating effect of overtraining upon RS performance. An additional finding is that overtraining also facilitates NRS-ND and NRS-ID performance. The failure to confirm either hypothesis concerning overtraining raises questions concerning the operation of an analyzing mechanism which is dimension specific or common only to normal Ss. The effects of overtraining are more consistent with an error reduction theory such as proposed by Harlow (1959), than a two-factor theory such as proposed by Sutherland (1959). Harlow's theory could predict a facilitating effect of overtraining upon all three types of transfer performance.

It is of special interest that the difference which appears between normal and retarded $\underline{S}$s on RS performance after criterional learning appears to be considerably diminished following overtraining. Another comparison of possible theoretical significance is that of the RS performance of retardates following overtraining (Mean= 5.56) with that of the RS performance of normal $\underline{S}$s following criterional learning (Mean=7.81). Overtraining effectively facilitated RS performance in retardates to the point that their performance was, at least, equal to that of the RS performance of normal $\underline{S}$s who had received criterional learning. This finding raises further questions as to what kind of learning processes are taking place during overtraining and whether these processes could be isolated and possibly applied to other transformational tasks.

In the main, the results of this study are not completely consistent with the view that there is a fundamental discontinuity between discrimination learning of normal and retarded children. This follows from the failure to find reliable learner and learner x shift interactions and from the finding that overtraining effected both groups of $\underline{S}$s in the same manner. If normal $\underline{S}$s are superior to retarded $\underline{S}$s in RS performance because of mediational responses, then it appears that such responses or similar responses may be developed in retarded $\underline{S}$s by extended training on the original learning tasks.

Summary

Normal and retarded children equated for chronological age were assigned to two levels of training (criterion and overtraining) on a simultaneous two-choice discrimination task. Following training on the original task subjects were transferred to a reversal shift (switching of positive and negative cues within a relevant dimension), nonreversal shift-new dimension (introduction of a new and different dimension after learning the original task) or nonreversal shift—irrelevant dimension (a dimension present but irrelevant in the original task becomes relevant in the transfer task). The experiment was thus of the 2 x 3 x 2 variety with two learner groups, 3 varieties of transfer problems, and two levels of training on the original task.

There was a significant shift effect with reversal and nonreversal— irrelevant dimension shifts being more difficult than nonreversal— new dimension shifts. There was also a significant training effect indicating a general facilitating effect of overtraining both for normal and retarded subjects and for all transfer tasks.

There was not a reliable learner effect or learner x shift interaction effect although the direction of the interaction was consistent with other studies indicating faster reversal shift performance by normal as opposed to retarded subjects. None of the other interactions were significant.

The failure to find reliable learner and learner x shift interactions was interpreted as casting some doubt on the view that there is a fundamental discontinuity between the discrimination performance of normal and retarded subjects. The study suggests a need for further investigation of reasons for the facilitating effects of overtraining.

Study II

A second study was undertaken to investigate the effects of verbalization upon transfer performance of retarded Ss working RS, NRS-ND, and NRS-ID type problems. An additional 48 retarded Ss, including 16 in each of 3 groups, were given criterional training and subsequently transferred to one of the 3 types of problems. These subjects were all given instructions to verbalize the positive and negative cues in the original task. Performance of these Ss was then compared to the performance of the 48 retarded Ss who were given criterional training in Experiment I. Results are presented in Tables 2 and 3 (see Appendix 2). The results are supportive of the shift effect obtained in Experiment I but fail to show any effect of verbalization upon transfer performance.

Close examination of Table 2 does indicate an obvious effect of verbalization upon learning of the original task. An analysis of variance based on the original learning data indicates a significant verbalization effect ($F=16.93$, $df=1/90$, $P < .001$). Thus it appears that verbalization may facilitate specific learning tasks of retardates but has limited facilitating effects upon transfer tasks.

Appendix I

Table I

Means and SD's of Untransformed Trials to Criterion[1] for all Learning Conditions

Groups		Original Learning M	SD	Transfer M	SD
	RS (C)	29.12	22.00	15.00	12.61
	RS(OT)	28.69	22.34	5.56	5.02
Retardates	NRS-ND (C)	22.62	18.55	5.56	11.84
	NRS-ND(OT)	19.44	17.27	.88	1.31
	NRS-ID (C)	43.38	21.37	22.25	23.49
	NRS-ID(OT)	31.88	17.11	10.81	16.27
	RS (C)	30.56	22.46	7.81	7.15
	RS(OT)	29.50	21.98	2.62	3.24
Normals	NRS-ND (C)	27.69	18.69	4.31	5.55
	NRS-ND(OT)	18.28	17.50	.81	1.28
	NRS-ID (C)	21.75	11.80	6.81	9.01
	NRS-ID(OT)	22.25	19.95	7.19	7.89

[1]The constant 9 was subtracted from each S's score.

Appendix II

Table 2

Means and Standard Deviations of Untransformed Trials to Criterion for all Learning Conditions

Groups		Initial Learning		Shift Learning	
		M	SD	M	SD
Verbalization	RS	18.81	14.52	7.19	6.71
	NRS-ND	12.44	10.22	5.25	10.02
	NRS-ID	19.25	16.64	16.75	21.91
No Verbalization	RS	29.12	22.00	15.00	12.61
	NRS-ND	22.62	18.55	5.56	11.84
	NRS-ID	43.48	21.37	22.25	23.49

Table [illegible]

Analysis of Covariance[1] for Study II

[illegible]	SS	df	Mean Square	F	p
A (Verbalization)	4.34	1	4.34	1.10	
B (Shift)	49.20	2	24.60	6.21	.01
A x B	4.57	2	2.29		
Error	352.52	89	3.96		

[1] Based on $\sqrt{X \& 0.5}$ transformation

References

Balla, D. & Zigler, E. Discrimination and switching learning in normal, familial retarded, and organic retarded children.

Cross, H.A. & Tyer, Z.A. The overlearning reversal effect in preschool children as a function of age. *Psychon. Sci.*, 1966, 6, 175-176.

Harlow, H.F. Learning set and error factor theory. In S. Koch (Ed.), *Psychology: A Study of a Science*. Vol.2. New York: McGraw-Hill, 1959, 492-537.

Kendler, H.H. & D'Amato, M.F. A comparison of reversal shifts and nonreversal shifts in human concept formation behavior. *J. exp. Psychol.*, 1955, 49, 165-174.

Kendler, T.S. & Kendler, H.H. Reversal and nonreversal shifts in kindergarten children. *J. exp. Psychol.*, 1959, 58, 56-60.

Kendler, T.S., Kendler, H.H., & Wells, Doris. Reversal and nonreversal shifts in nursery school children. *J. comp. & phy. Psychol.*, 1960, 53, 83-88.

Luria, A.R. *The role of speech in the regulation of normal and non-normal behavior*. New York: Pergamon Press, 1961.

MacKintosh, N.J. The effects of overtraining on a reversal and a nonreversal shift. *J. comp. phy. Psychol.*, 1962, 55, 555-559.

Sanders, B., Ross, L.E., & Heal, L.W. Reversal and nonreversal shift learning in normal children and retardates of comparable mental age. *J. exp. Psychol.*, 1965, 69, 84-88.

Sitterley, T.E., & Capehart, J.E. Human successive discrimination reversal: effects of overtraining and reinforcement. *Psychon. Sci.*, 1966, 4, 293-294.

Sutherland, N.S. Stimulus analyzing mechanisms. In *Proceedings of a Symposium on the Mechanization of Thought Processes*. Vol. 2. London, England: Her Majesty's Stationary Office, 1959, 575-609.

Youniss, J. & Furth, H.G. Reversal learning in children as a function of overtraining and delayed transfer. *J. comp. phy. Psychol.*, 1964, 57, 155-157.